



TFT LCD Approval Specification

MODEL NO.: N156O6-L01(Rev: C4)

Customer : HP

Approved by : _____

Note : _____

核准時間	部門	審核	角色	投票
2009-12-16 19:54:51	NB 產品管理處		Director	Accept



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11. DEFINITION OF LABELS

- 11.1 CMO MODULE LABEL
- 11.2 CARTON LABEL

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REVISION HISTORY

Version	Date	Page (New)	Section	Description
Ver 3.0	May, 05 2009	All	All	Approval Spec is first issued
Ver 3.1	Jun, 11 2009	32	Drawing	Modify Outline Drawing--PCB Size
Ver 3.2	July, 17 2009	32	Drawing	Modify PCBA LVDS Connector Location
Ver 3.3	Sep, 11 2009	18	6.2	Update PWM Control Duty Ratio Min and Frequency Max
Ver 3.4	Dec, 08 2009			Update Spec Version to C4 to apply on HP WWAN platform



1. GENERAL DESCRIPTION

1.1 OVERVIEW

N156O6-L01 is a 15.6" (15.547" diagonal)TFT Liquid Crystal Display module with LED Backlight unit and 40 pins LVDS interface. This module supports 1600 x 900 HD+ mode and can display 262,144 colors. The optimum viewing angle is at 6 o'clock direction. The converter module for backlight is built in.

1.2 FEATURES

- HD+ (1600x900 pixels) resolution.
- VESA standard LED model.
- 3.3V LVDS (Low Voltage Differential Signaling) interface with 2 pixel/clock
- RoHS compliance

1.3 APPLICATION

- TFT LCD Notebook

1.4 GENERAL SPECIFICATIONS

Item	Specification	Unit	Note
Active Area	344.16 (H) x 193.59 (V) (15.547" diagonal)	mm	(1)
Bezel Opening Area	348.76(H)x197.19(V)	mm	
Driver Element	a-si TFT active matrix	-	-
Pixel Number	1600 x R.G.B. x 900	pixel	-
Pixel Pitch	0.215 (H) x 0.215 (V)	mm	-
Pixel Arrangement	RGB vertical stripe	-	-
Display Colors	262,144	color	-
Transmissive Mode	Normally white	-	-
Surface Treatment	Hard coating (3H), Anti-Glare	-	-

1.5 MECHANICAL SPECIFICATIONS

Item	Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal(H)	358.8	359.3	mm	(1)
	Vertical(V)	209	209.5	mm	
	Thickness(T)		5.2	mm	
Weight		440	455	g	

Note (1) Please refer to the attached drawings for more information of front and back outline dimensions.



2. ABSOLUTE MAXIMUM RATINGS

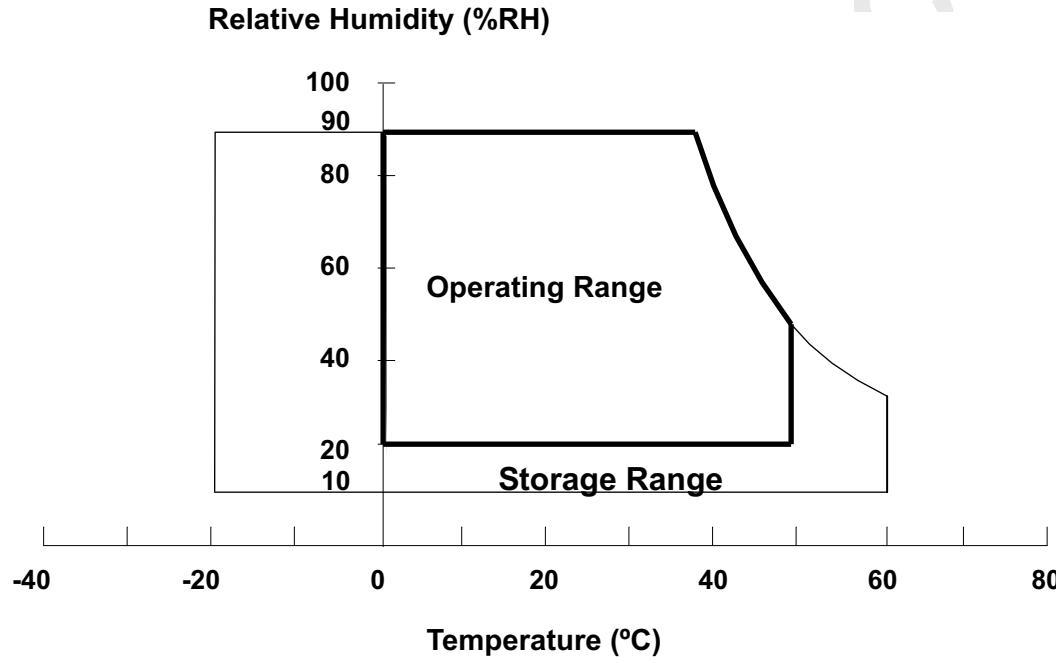
2.1 ABSOLUTE RATINGS OF ENVIRONMENT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Storage Temperature	T_{ST}	-20	+60	°C	(1)
Operating Ambient Temperature	T_{OP}	0	+50	°C	(1), (2)
Shock (Non-Operating)	S_{NOP}	-	220/2	G/ms	(3), (5)
Vibration (Non-Operating)	V_{NOP}	-	1.5	G	(4), (5)

Note (1) Temperature and relative humidity range is shown in the figure below.

- (a) 90 %RH Max. ($T_a \leq 40$ °C).
- (b) Wet-bulb temperature should be 39 °C Max. ($T_a > 40$ °C).
- (c) No condensation.

Note (2) The temperature of panel surface area should be 0 °C min. and 60 °C max.

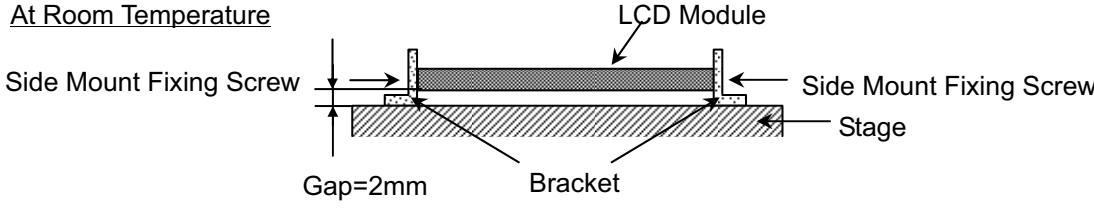


Note (3) 1 time for $\pm X$, $\pm Y$, $\pm Z$. for Condition (220G / 2ms) is half Sine Wave.,.

Note (4) 10~500 Hz, 30 min/cycle, 1cycle for X,Y,Z-axis.

Note (5) At testing Vibration and Shock, the fixture in holding the module has to be hard and rigid enough so that the module would not be twisted or bent by the fixture.

The fixing condition is shown as below:





2.2 ELECTRICAL ABSOLUTE RATINGS

2.2.1 TFT LCD MODULE

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Power Supply Voltage	V _{CC}	-0.3	+4.0	V	(1)
Logic Input Voltage	V _{IN}	-0.3	V _{CC} +0.3	V	

2.2.2 BACKLIGHT UNIT

Item	Value		Unit	Note
	Min	Max.		
LED Light Bar Power Supply Voltage	-50	34	V _{DC}	(1), (2)
LED Light Bar Power Supply Current	0	150	mA _{DC}	

Note (1) Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under Normal Operating Conditions.

Note (2) Specified values are for LED (Refer to Section 3.2 for further information).



3. ELECTRICAL CHARACTERISTICS

3.1 TFT LCD MODULE

$T_a = 25 \pm 2 ^\circ C$

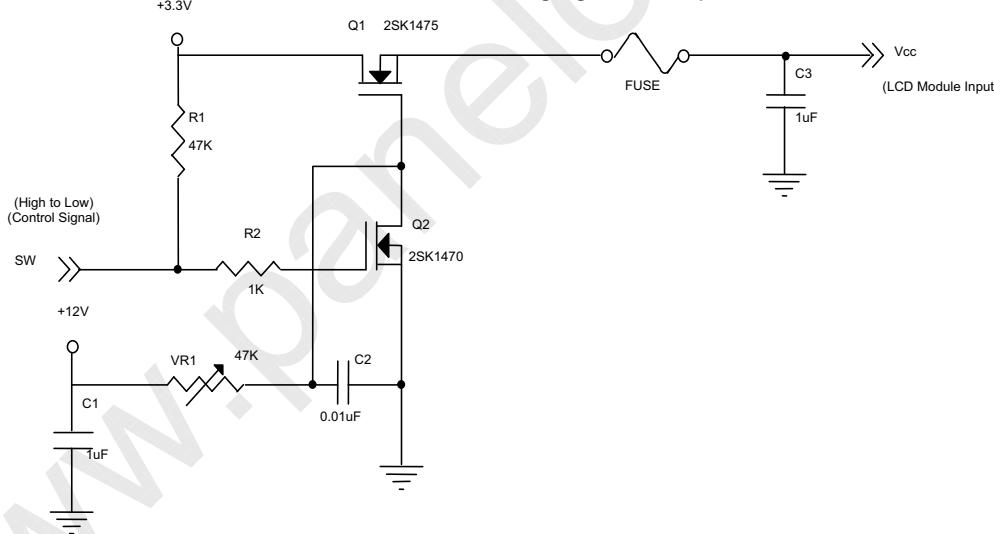
Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Power Supply Voltage	V _{CC}	3.0	3.3	3.6	V	-
Ripple Voltage	V _{RP}	-	50	-	mV	-
Rush Current	I _{RUSH}	-	-	1.5	A	(2)
Initial Stage Current	I _{IS}	-	-	1.0	A	(2)
Power Supply Current	I _{CC}	White	-	255	mA	(3)a
Black			-	355	mA	(3)b
LVDS Differential Input High Threshold	V _{TH(LVDS)}	-	-	+100	mV	(5), V _{CM} =1.2V
LVDS Differential Input Low Threshold	V _{TL(LVDS)}	-100	-	-	mV	(5) V _{CM} =1.2V
LVDS Common Mode Voltage	V _{CM}	1.125	-	1.375	V	(5)
LVDS Differential Input Voltage	V _{ID}	100	-	600	mV	(5)
Terminating Resistor	R _T	-	100	-	Ohm	-
Power per EBL WG	P _{EBL}	-	2.2	-	W	(4)

Note (1) The ambient temperature is $T_a = 25 \pm 2 ^\circ C$.

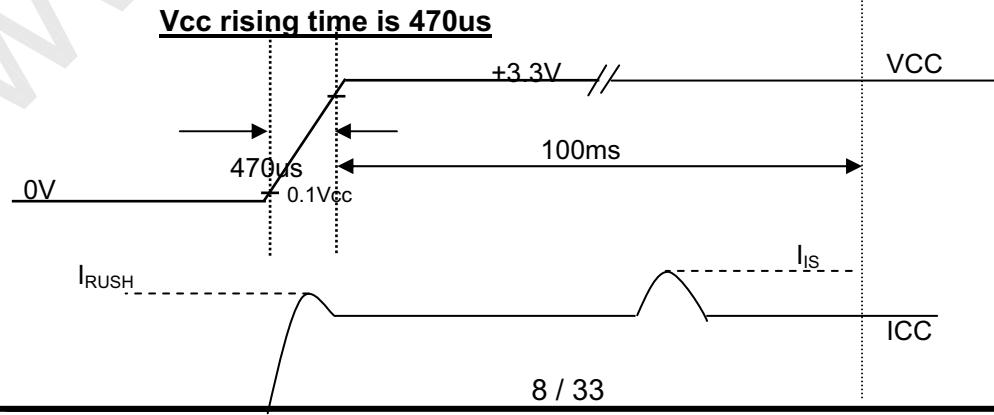
Note (2) I_{RUSH}: the maximum current when VCC is rising

I_{IS}: the maximum current of the first 100ms after power-on

Measurement Conditions: Shown as the following figure. Test pattern: black.



V_{CC} rising time is 470us

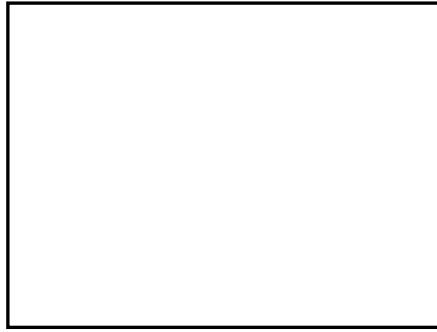




Note (3) The specified power supply current is under the conditions at $V_{cc} = 3.3$ V, $T_a = 25 \pm 2$ °C, DC

Current and $f_v = 60$ Hz, whereas a power dissipation check pattern below is displayed.

a. White Pattern



Active Area

b. Black Pattern



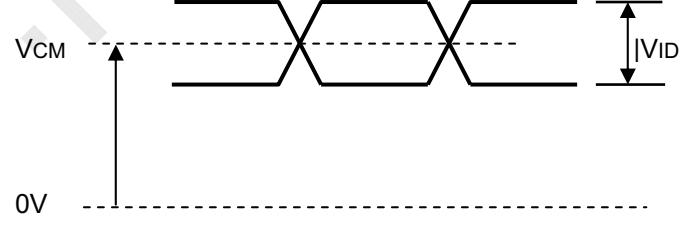
Active Area

Note (4) The specified power are the sum of LCD panel electronics input power and the converter input power. Test conditions are as follows.

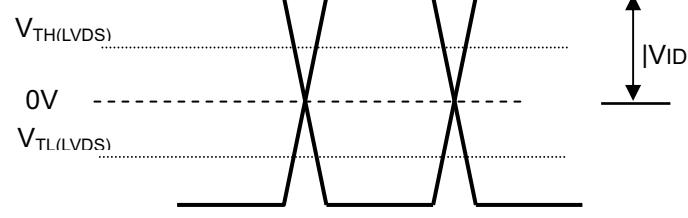
- (a) $V_{cc} = 3.3$ V, $T_a = 25 \pm 2$ °C, $f_v = 60$ Hz,
- (b) The pattern used is a black and white 32 x 36 checkerboard, slide #100 from the VESA file "Flat Panel Display Monitor Setup Patterns", FPDMSU.ppt.
- (c) Luminance: 60 nits.

Note (5) The parameters of LVDS signals are defined as the following figures.

Single Ended



Differential





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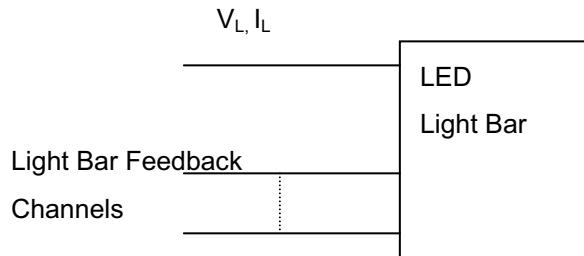
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3.2 BACKLIGHT UNIT

T_a = 25 ± 2 °C

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
LED light bar input voltage	V _L	29	32	34	V _{DC}	(1), (2)
LED light bar input current	I _L	114	120	126	mA _{DC}	
Power Consumption	P _L	3.306	3.84	4.284	W	(3) Duty=100%
LED Life Time	L _{LED}	15000	-	-	Hrs	(4)

Note (1) LED light bar configuration is shown as below.



Note (2) For better LED light bar driving quality, it is recommended to utilize the adaptive boost converter with current balancing function to drive LED light-bar.

Note (3) P_L = I_L × V_L

Note (4) The lifetime of LED is defined as the time when it continues to operate under the conditions at T_a = 25 ± 2 °C and IL = 20.0 mA(Per EA) until the brightness becomes ≤ 50% of its original value.

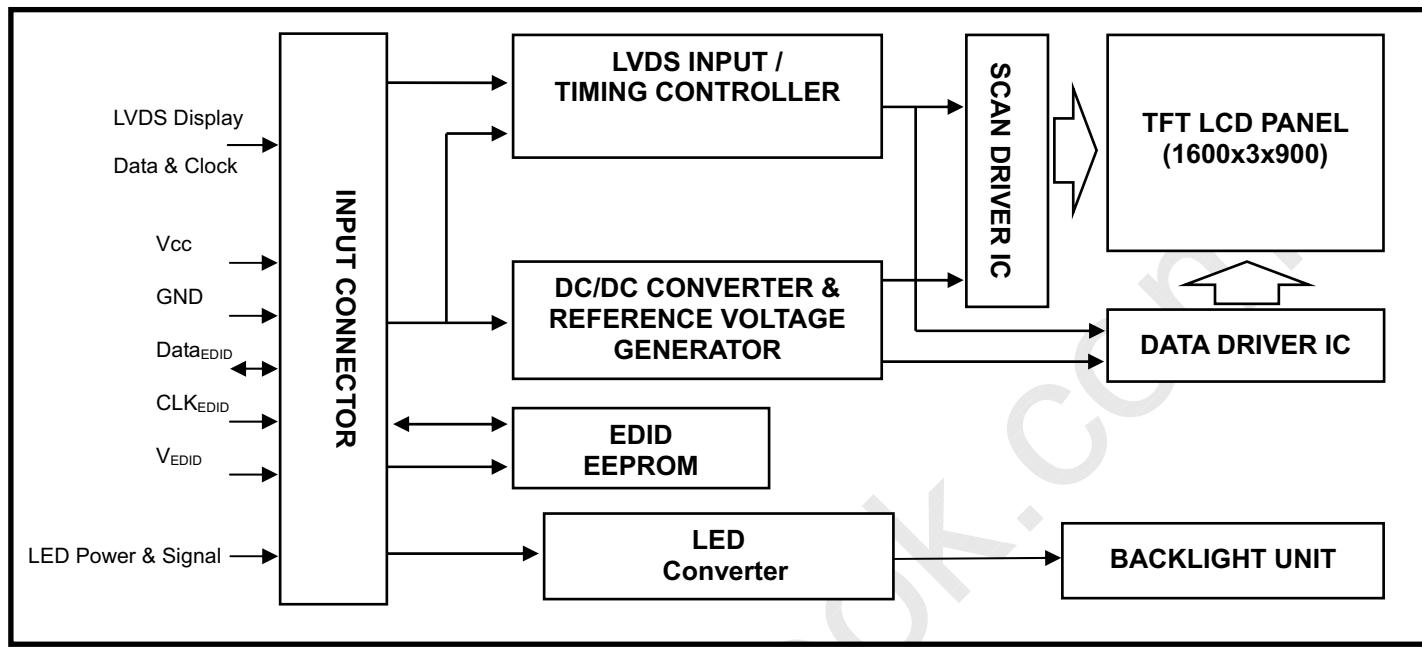


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4. BLOCK DIAGRAM

4.1 TFT LCD MODULE





5. INPUT TERMINAL PIN ASSIGNMENT

5.1 TFT LCD MODULE

Pin	Symbol	Description	Polarity	Remark
1	NC	No Connection.		
2	AVDD	Power Supply, 3.3V (typical)		
3	AVDD	Power Supply, 3.3V (typical)		
4	DVDD	DDC 3.3V power		
5	NC	No Connect		
6	SCL	DDC Clock		
7	SDA	DDC Data		
8	RXO0-	LVDS Differential Data Input (Odd)	Negative	
9	RXO0+	LVDS Differential Data Input (Odd)	Positive	
10	Vss	Ground		
11	RXO1-	LVDS Differential Data Input (Odd)	Negative	
12	RXO1+	LVDS Differential Data Input (Odd)	Positive	
13	Vss	Ground		
14	RXO2-	LVDS Differential Data Input (Odd)	Negative	
15	RXO2+	LVDS Differential Data Input (Odd)	Positive	
16	Vss	Ground		
17	RXOC-	LVDS Clock Data Input (Odd)	Negative	
18	RXOC+	LVDS Clock Data Input (Odd)	Positive	
19	Vss	Ground		
20	RxE0-	LVDS Differential Data Input (Even)	Negative	
21	RxE0+	LVDS Differential Data Input (Even)	Positive	
22	Vss	Ground		
23	RxE1-	LVDS Differential Data Input (Even)	Negative	
24	RxE1+	LVDS Differential Data Input (Even)	Positive	
25	Vss	Ground		
26	RxE2-	LVDS Differential Data Input (Even)	Negative	
27	RxE2+	LVDS Differential Data Input (Even)	Positive	
28	Vss	Ground		
29	RXEC-	LVDS Clock Data Input (Even)	Negative	
30	RXEC+	LVDS Clock Data Input (Even)	Positive	
31	LED_GND	LED Ground		
32	LED_GND	LED Ground		
33	LED_GND	LED Ground		
34	NC	No Connection		
35	LED_PWM	PWM Control Signal of LED Converter		
36	LED_EN	Enable Control Signal of LED Converter		
37	NC	No Connection		
38	LED_VCCS	LED Power		
39	LED_VCCS	LED Power		
40	LED_VCCS	LED Power		

Note (1) Connector Part No.: I-PEX 20455-040E-12 or equivalent

Note (2) User's connector Part No: I-PEX 20453-040T-01 or equivalent

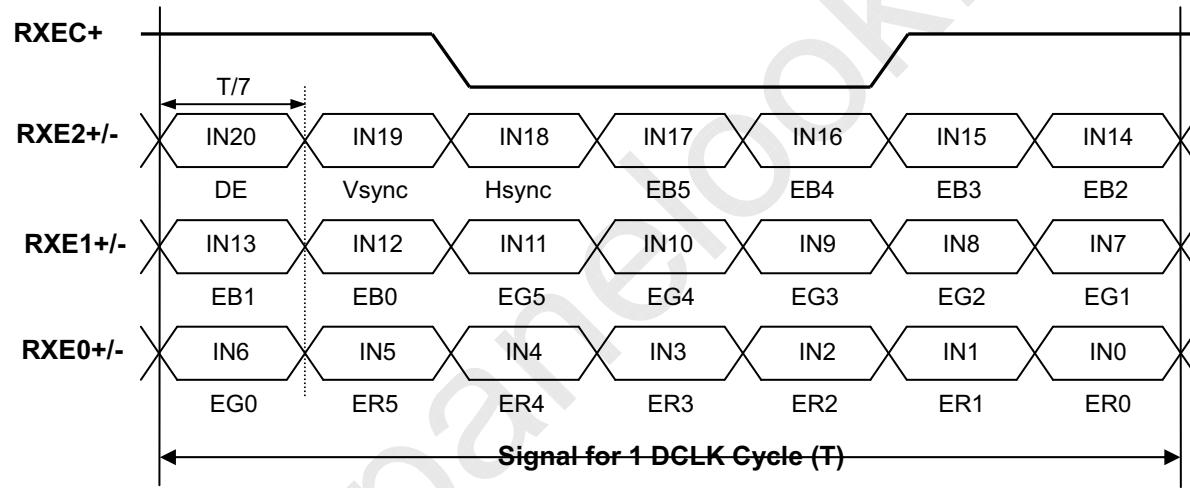
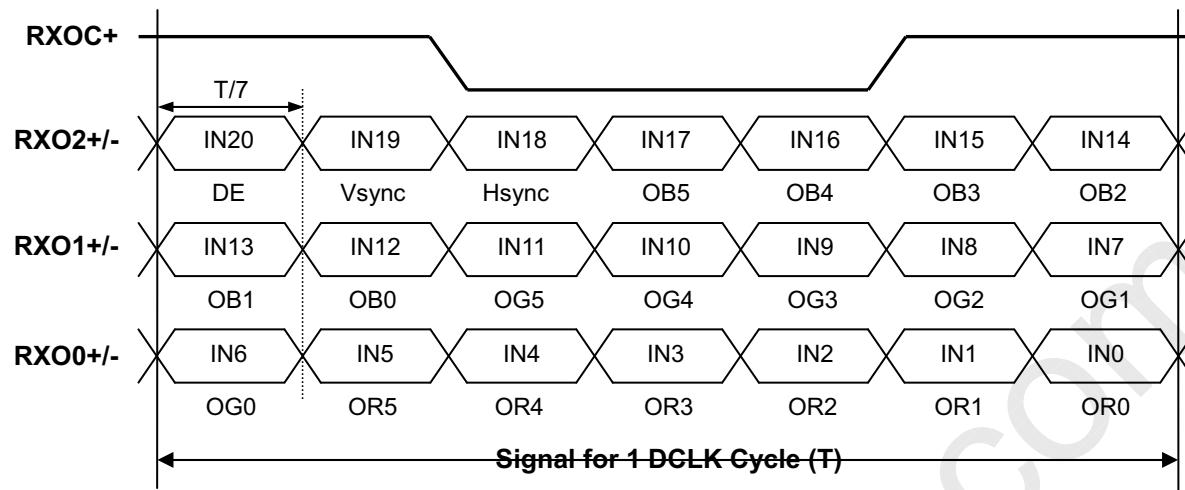
Note (3) The first pixel is odd as shown in the following figure.





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5.2 TIMING DIAGRAM OF LVDS INPUT SIGNAL





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5.3 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 6-bit gray scale data input for the color. The higher the binary input the brighter the color. The table below provides the assignment of color versus data input.

Color		Data Signal																	
		Red						Green						Blue					
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
Basic Colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Gray Scale Of Red	Red(0)/Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(1)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(2)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	Red(61)	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(62)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(64)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
Gray Scale Of Green	Green(0)/Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green(1)	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	Green(2)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	Green(61)	0	0	0	0	0	0	1	1	1	1	1	0	1	0	0	0	0	0
	Green(62)	0	0	0	0	0	0	1	1	1	1	1	0	1	0	0	0	0	0
	Green(63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Green(64)	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0
Gray Scale Of Blue	Blue(0)/Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Blue(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	Blue(61)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1
	Blue(62)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	Blue(63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	Blue(64)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

Note (1) 0: Low Level Voltage, 1: High Level Voltage



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5.4 EDID DATA STRUCTURE

The EDID (Extended Display Identification Data) data formats are to support displays as defined in the VESA Plug & Display and FPDI standards.

Byte # (decimal)	Byte # (hex)	Field Name and Comments	Value (hex)	Value (binary)
0	0	Header	00	00000000
1	1	Header	FF	11111111
2	2	Header	FF	11111111
3	3	Header	FF	11111111
4	4	Header	FF	11111111
5	5	Header	FF	11111111
6	6	Header	FF	11111111
7	7	Header	00	00000000
8	8	EISA ID manufacturer name ("CMO")	0D	00001101
9	9	EISA ID manufacturer name (Compressed ASCII)	AF	10101111
10	0A	ID product code (N156O6-L01)	95	10010101
11	0B	ID product code (hex LSB first; N156O6-L01)	15	00010101
12	0C	ID S/N (fixed "0")	00	00000000
13	0D	ID S/N (fixed "0")	00	00000000
14	0E	ID S/N (fixed "0")	00	00000000
15	0F	ID S/N (fixed "0")	00	00000000
16	10	Week of manufacture (fixed week code)	0C	00001100
17	11	Year of manufacture (fixed year code)	13	00010011
18	12	EDID structure version # ("1")	01	00000001
19	13	EDID revision # ("3")	03	00000011
20	14	Video I/P definition ("digital")	80	10000000
21	15	Active area horizontal 34.416cm	22	00100010
22	16	Active area vertical 19.359cm	13	00010011
23	17	Display Gamma (Gamma = "2.2")	78	01111000
24	18	Feature support ("Active off, RGB Color")	0A	00001010
25	19	Rx1, Rx0, Ry1, Ry0, Gx1, Gx0, Gy1, Gy0	7B	01111011
26	1A	Bx1, Bx0, By1, By0, Wx1, Wx0, Wy1, Wy0	95	10010101
27	1B	Rx=0.610	9C	10011100
28	1C	Ry=0.343	57	01010111
29	1D	Gx=0.342	57	01010111
30	1E	Gy=0.581	94	10010100
31	1F	Bx=0.162	29	00101001
32	20	By=0.083	15	00010101
33	21	Wx=0.313	50	01010000
34	22	Wy=0.329	54	01010100
35	23	Established timings 1	00	00000000
36	24	Established timings 2	00	00000000
37	25	Manufacturer's reserved timings	00	00000000
38	26	Standard timing ID # 1	01	00000001
39	27	Standard timing ID # 1	01	00000001



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40	28	Standard timing ID # 2	01	00000001
41	29	Standard timing ID # 2	01	00000001
42	2A	Standard timing ID # 3	01	00000001
43	2B	Standard timing ID # 3	01	00000001
44	2C	Standard timing ID # 4	01	00000001
45	2D	Standard timing ID # 4	01	00000001
46	2E	Standard timing ID # 5	01	00000001
47	2F	Standard timing ID # 5	01	00000001
48	30	Standard timing ID # 6	01	00000001
49	31	Standard timing ID # 6	01	00000001
50	32	Standard timing ID # 7	01	00000001
51	33	Standard timing ID # 7	01	00000001
52	34	Standard timing ID # 8	01	00000001
53	35	Standard timing ID # 8	01	00000001
54	36	Detailed timing description # 1 Pixel clock ("107.8MHz", According to VESA CVT Rev1.1)	1C	00011100
55	37	# 1 Pixel clock (hex LSB first)	2A	00101010
56	38	# 1 H active ("1600")	40	01000000
57	39	# 1 H blank ("292")	24	00100100
58	3A	# 1 H active : H blank ("1600 : 292")	61	01100001
59	3B	# 1 V active ("900")	84	10000100
60	3C	# 1 V blank ("49")	31	00110001
61	3D	# 1 V active : V blank ("900 :49")	30	00110000
62	3E	# 1 H sync offset ("26")	1A	00011010
63	3F	# 1 H sync pulse width ("60")	3C	00111100
64	40	# 1 V sync offset : V sync pulse width ("9: 10")	9A	10011010
65	41	# 1 H sync offset : H sync pulse width : V sync offset : V sync width ("26: 60 : 9 : 10")	00	00000000
66	42	# 1 H image size ("344 mm")	58	01011000
67	43	# 1 V image size ("193 mm")	C1	11000001
68	44	# 1 H image size : V image size ("344 : 193")	10	00010000
69	45	# 1 H boarder ("0")	00	00000000
70	46	# 1 V boarder ("0")	00	00000000
71	47	# 1 Non-interlaced, Normal, no stereo, Separate sync, H/V pol Negatives	18	00011000
72	48	Detailed timing description # 2	00	00000000
73	49	# 2 Flag	00	00000000
74	4A	# 2 Reserved	00	00000000
75	4B	# 2 FE (hex) defines ASCII string (Model Name "N156O6-L01", ASCII)	FE	11111110
76	4C	# 2 Flag	00	00000000
77	4D	# 2 1st character of name ("N")	4E	01001110
78	4E	# 2 2nd character of name ("1")	31	00110001
79	4F	# 2 3rd character of name ("5")	35	00110101
80	50	# 2 4th character of name ("6")	36	00110110
81	51	# 2 5th character of name ("O")	4F	01001111
82	52	# 2 6th character of name ("6")	36	00110110
83	53	# 2 7th character of name ("-")	2D	00101101



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84	54	# 2 8th character of name ("L")	4C	01001100
85	55	# 2 9th character of name ("0")	30	00110000
86	56	# 2 9th character of name ("1")	31	00110001
87	57	# 2 New line character indicates end of ASCII string	0A	00001010
88	58	# 2 Padding with "Blank" character	20	00100000
89	59	# 2 Padding with "Blank" character	20	00100000
90	5A	Detailed timing description # 3	00	00000000
91	5B	# 3 Flag	00	00000000
92	5C	# 3 Reserved	00	00000000
93	5D	# 3 FE (hex) defines ASCII string (Vendor "CMO", ASCII)	FE	11111110
94	5E	# 3 Flag	00	00000000
95	5F	# 3 1st character of string ("C")	43	01000011
96	60	# 3 2nd character of string ("M")	4D	01001101
97	61	# 3 3rd character of string ("O")	4F	01001111
98	62	# 3 New line character indicates end of ASCII string	0A	00001010
99	63	# 3 Padding with "Blank" character	20	00100000
100	64	# 3 Padding with "Blank" character	20	00100000
101	65	# 3 Padding with "Blank" character	20	00100000
102	66	# 3 Padding with "Blank" character	20	00100000
103	67	# 3 Padding with "Blank" character	20	00100000
104	68	# 3 Padding with "Blank" character	20	00100000
105	69	# 3 Padding with "Blank" character	20	00100000
106	6A	# 3 Padding with "Blank" character	20	00100000
107	6B	# 3 Padding with "Blank" character	20	00100000
108	6C	Detailed timing description # 4	00	00000000
109	6D	# 4 Flag	00	00000000
110	6E	# 4 Reserved	00	00000000
111	6F	# 4 FE (hex) defines ASCII string (Model Name "N156O6-L01", ASCII)	FE	11111110
112	70	# 4 Flag	00	00000000
113	71	# 4 1st character of name ("N")	4E	01001110
114	72	# 4 2nd character of name ("1")	31	00110001
115	73	# 4 3rd character of name ("5")	35	00110101
116	74	# 4 4th character of name ("6")	36	00110110
117	75	# 4 5th character of name ("O")	4F	01001111
118	76	# 4 6th character of name ("6")	36	00110110
119	77	# 4 7th character of name ("")	2D	00101101
120	78	# 4 8th character of name ("L")	4C	01001100
121	79	# 4 9th character of name ("0")	30	00110000
122	7A	# 4 9th character of name ("1")	31	00110001
123	7B	# 4 New line character indicates end of ASCII string	0A	00001010
124	7C	# 4 Padding with "Blank" character	20	00100000
125	7D	# 4 Padding with "Blank" character	20	00100000
126	7E	Extension flag	00	00000000
127	7F	Checksum	1C	00011100



6. CONVERTER SPECIFICATION

6.1 ABSOLUTE MAXIMUM RATINGS

Symbol	Ratings
LED_VCCS	28
PWM	-0.3V~5.5V
EN	-0.3V~5.5V

6.2 RECOMMENDED OPERATING RATINGS

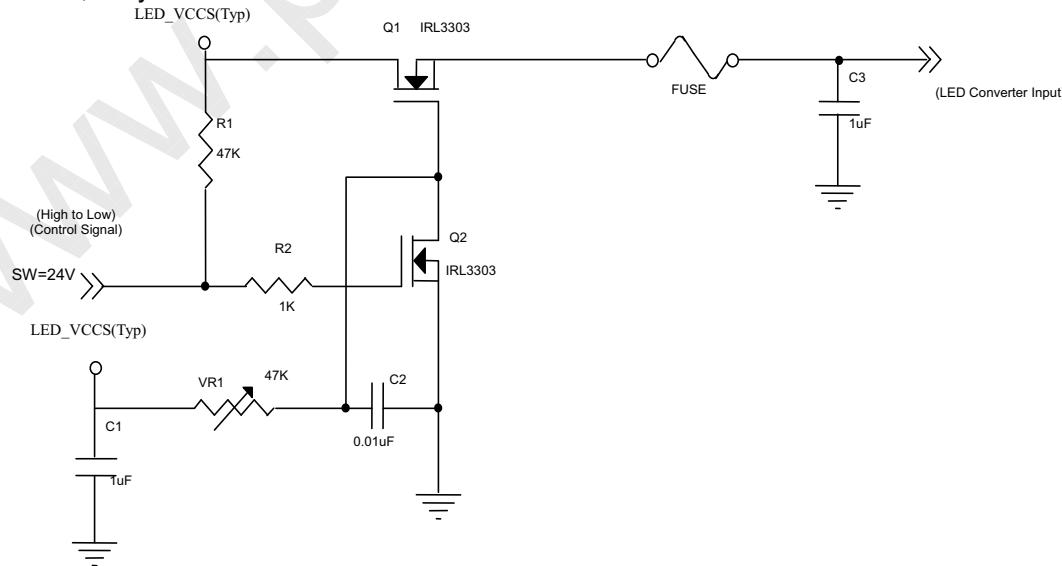
Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Converter Input power supply voltage	LED_Vccs	6.0	12.0	21.0	V	
Converter Rush Current	ILED_RUSH	-	-	1.5	A	(2)
Converter Initial Stage Current	ILED_IS	-	-	1.5	A	(2)
EN Control Level	Backlight on	1.6	---	5	V	
		0	---	0.8	V	
PWM Control Level	PWM High Level	1.3	---	5	V	
		0	---	0.65	V	
PWM Control Duty Ratio		10		100	%	
PWM Control Permissive Ripple Voltage	VPWM_pp			100	mV	
PWM Control Frequency	f_PWM	190	210	1000	Hz	
Converter Input Current	I_BL	633	753	893	mA	(1)
		317	376	446	mA	(1)
		181	215	255	mA	(1)

Note (1) The specified LED power supply current is under the conditions at "LED_VCCS = 6V/12V/21V", Ta = 25 ± 2 °C, f_PWM = 200 Hz, Duty=100%.

Note (2) ILED_RUSH: the maximum current when LED_VCCS is rising,

ILED_IS: the maximum current of the first 100ms after power-on,

Measurement Conditions: Shown as the following figure. LED_VCCS = Typ, Ta = 25 ± 2 °C, f_PWM = 200 Hz, Duty=100%.

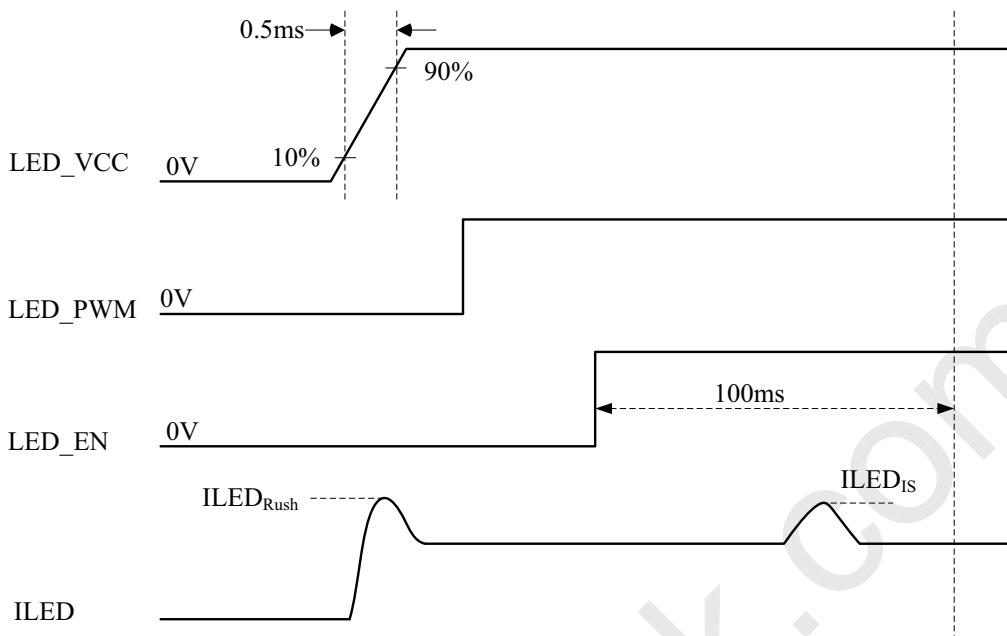


VLED rising time is 500us



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7. INTERFACE TIMING

7.1 INPUT SIGNAL TIMING SPECIFICATIONS

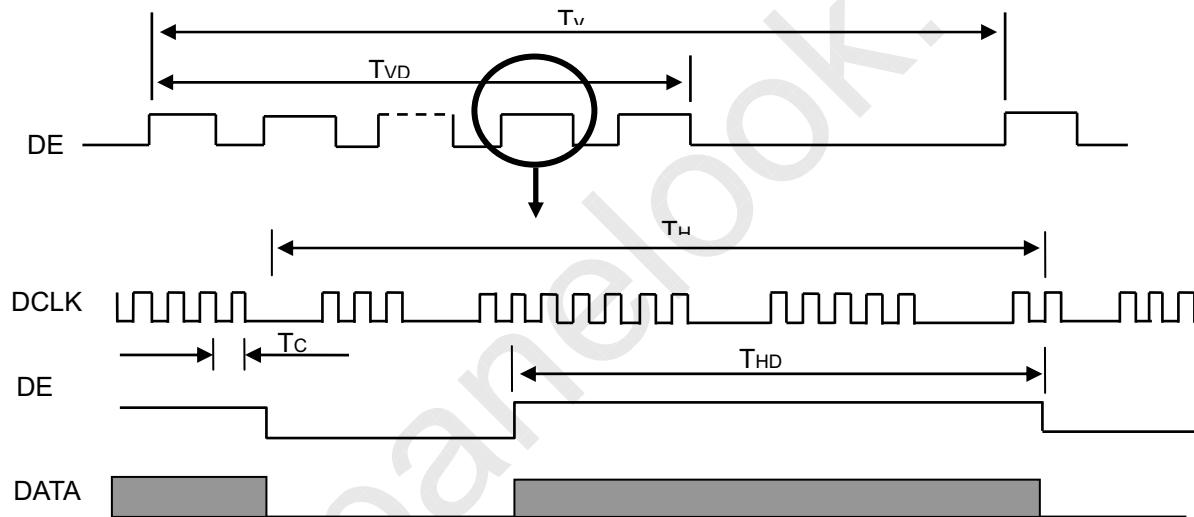
The input signal timing specifications are shown as the following table and timing diagram.

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
DCLK	Frequency	1/Tc	32.5	53.9	54.5	MHz	(2)
	Vertical Total Time	TV	910	949	952	TH	-
	Vertical Active Display Period	TVD	900	900	900	TH	-
	Vertical Active Blanking Period	TVB	TV-TVD	49	TV-TVD	TH	
	Horizontal Total Time	TH	1700	1892	1910	Tc	(2)
	Horizontal Active Display Period	THD	1600	1600	1600	Tc	(2)
	Horizontal Active Blanking Period	THB	TH-THD	292	TH-THD	Tc	(2)

Note (1) Because this module is operated by DE only mode, Hsync and Vsync are ignored.

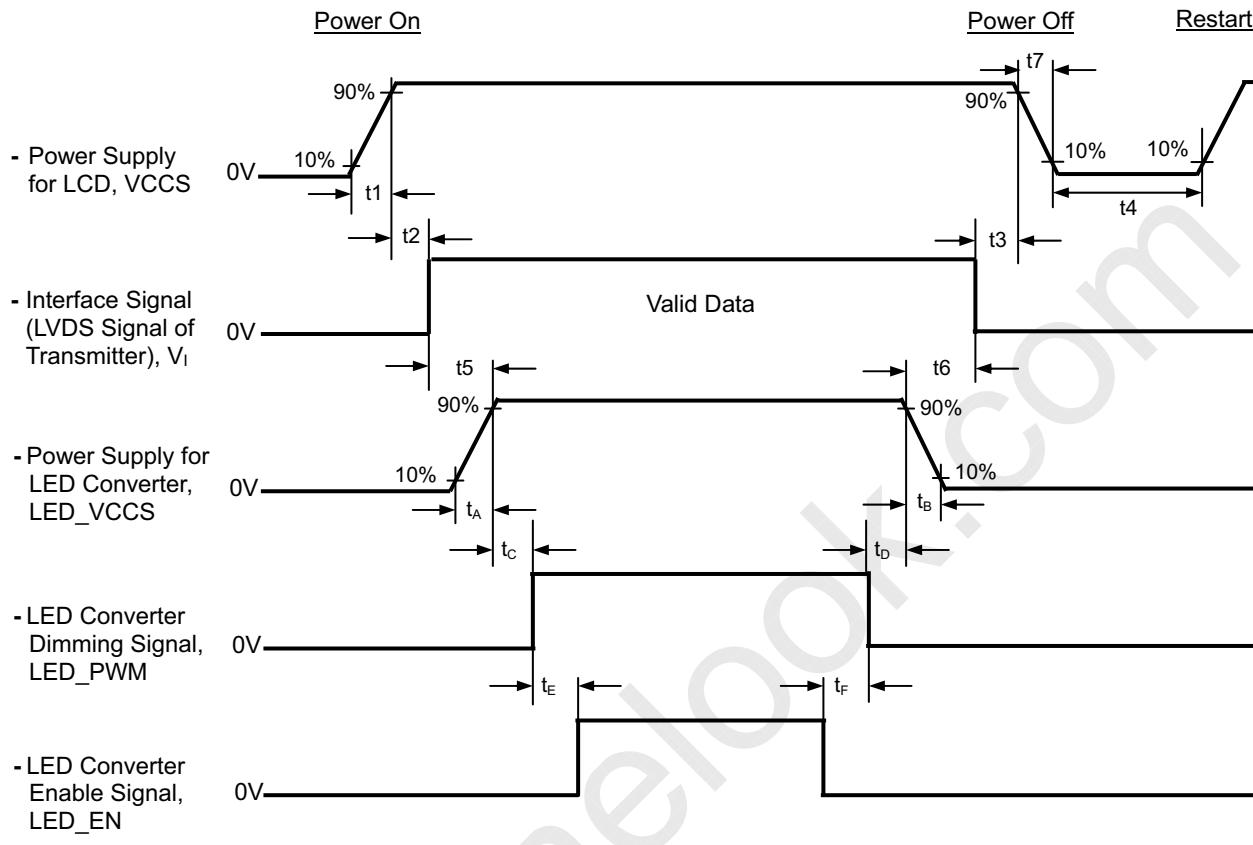
(2) 2 channels LVDS input.

INPUT SIGNAL TIMING DIAGRAM





7.2 POWER ON/OFF SEQUENCE



Timing Specifications:

$$0.5 \leq t_1 \leq 10 \text{ ms}$$

$$0 \leq t_2 \leq 50 \text{ ms}$$

$$0 \leq t_3 \leq 50 \text{ ms}$$

$$t_4 \geq 500 \text{ ms}$$

$$t_5 \geq 200 \text{ ms}$$

$$t_6 \geq 200 \text{ ms}$$

$$0.5 \leq t_7 \leq 10 \text{ ms}$$

$$0.5 \leq t_A \leq 10 \text{ ms}$$

$$0 \leq t_B \leq 10 \text{ ms}$$

$$t_C \geq 10 \text{ ms}$$

$$t_D \geq 10 \text{ ms}$$

$$t_E \geq 10 \text{ ms}$$

$$t_F \geq 10 \text{ ms}$$



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Note (1) Please follow the power on/off sequence described above. Otherwise, the LCD module might be damaged.

Note (2) Please avoid floating state of interface signal at invalid period. When the interface signal is invalid, be sure to pull down the power supply of LCD Vcc to 0 V.

Note (3) The Backlight converter power must be turned on after the power supply for the logic and the interface signal is valid. The Backlight converter power must be turned off before the power supply for the logic and the interface signal is invalid.

Note (4) Please follow the LED converter power sequence as above. If the customer could not follow, it might cause backlight flash issue during display ON/OFF or damage the LED backlight controller



8. OPTICAL CHARACTERISTICS

8.1 TEST CONDITIONS

Item	Symbol	Value	Unit
Ambient Temperature	T _a	25±2	°C
Ambient Humidity	H _a	50±10	%RH
Supply Voltage	V _{CC}	3.3	V
Input Signal		According to typical value in "3. ELECTRICAL CHARACTERISTICS"	
LED Light Bar Input Current	I _L	120	mA

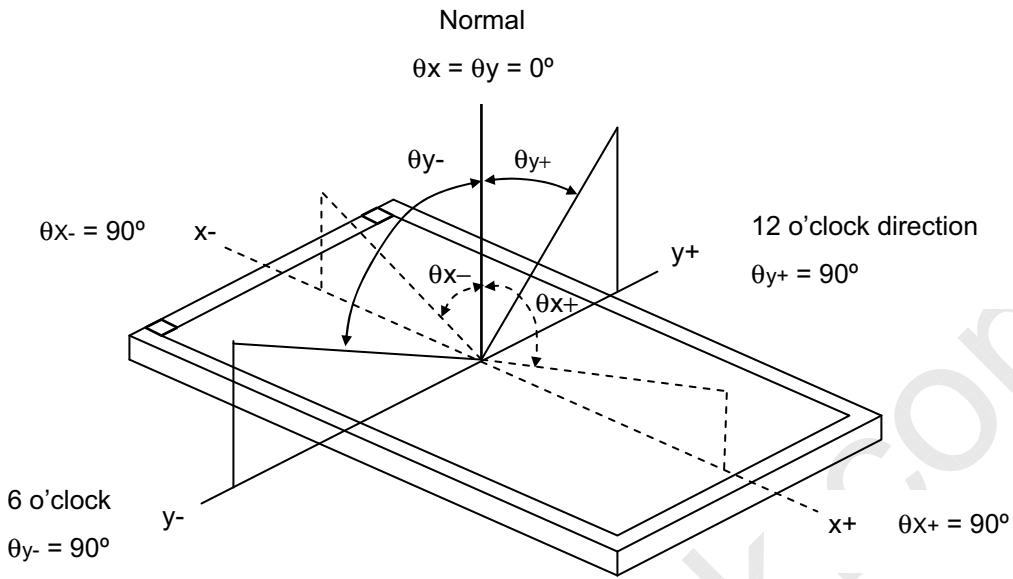
The measurement methods of optical characteristics are shown in Section 8.2. The following items should be measured under the test conditions described in Section 8.1 and stable environment shown in Note (5).

8.2 OPTICAL SPECIFICATIONS

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note	
Contrast Ratio	CR		400	500	-	-	(2), (5)	
Response Time	T _R	$\theta_x=0^\circ, \theta_Y=0^\circ$ Viewing Normal Angle	-	3	8	ms	(3)	
	T _F		-	5	10	ms		
Average Luminance of White	L _{AWE}		180	220	-	cd/m ²	(4), (5)	
Color Chromaticity	Red	$\theta_x=0^\circ, \theta_Y=0^\circ$ Viewing Normal Angle	0.610			-	(1), (7)	
			0.343			-		
	Green		0.342			-		
			0.581			-		
	Blue		-0.03	0.162		-	(1), (7)	
			0.083			-		
	White		0.313			-		
			0.329			-		
Viewing Angle	Horizontal	$CR\geq 10$	60	70	-	Deg.	(1),(5)	
			60	70	-			
	Vertical		50	60	-			
			50	60	-			
White Variation of 5 Points	δW _{5p}	$\theta_x=0^\circ, \theta_Y=0^\circ$	80	-	-	%	(5),(6)	



Note (1) Definition of Viewing Angle (θ_x, θ_y):



Note (2) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.

$$\text{Contrast Ratio (CR)} = L_{63} / L_0$$

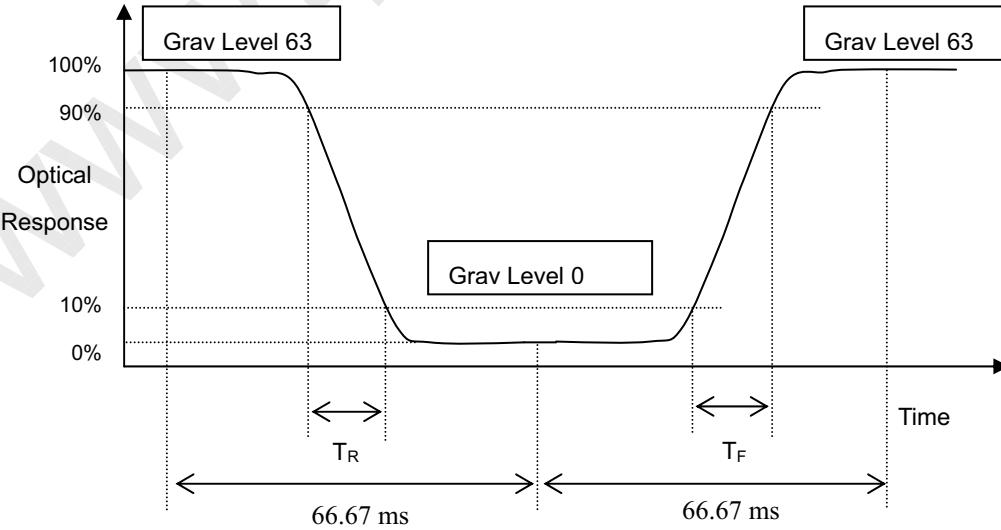
L_{63} : Luminance of gray level 63

L_0 : Luminance of gray level 0

$$CR = CR(5)$$

CR (X) is corresponding to the Contrast Ratio of the point X at Figure in Note (6).

Note (3) Definition of Response Time (T_R, T_F):





Note (4) Definition of Average Luminance of White (L_{AVE}):

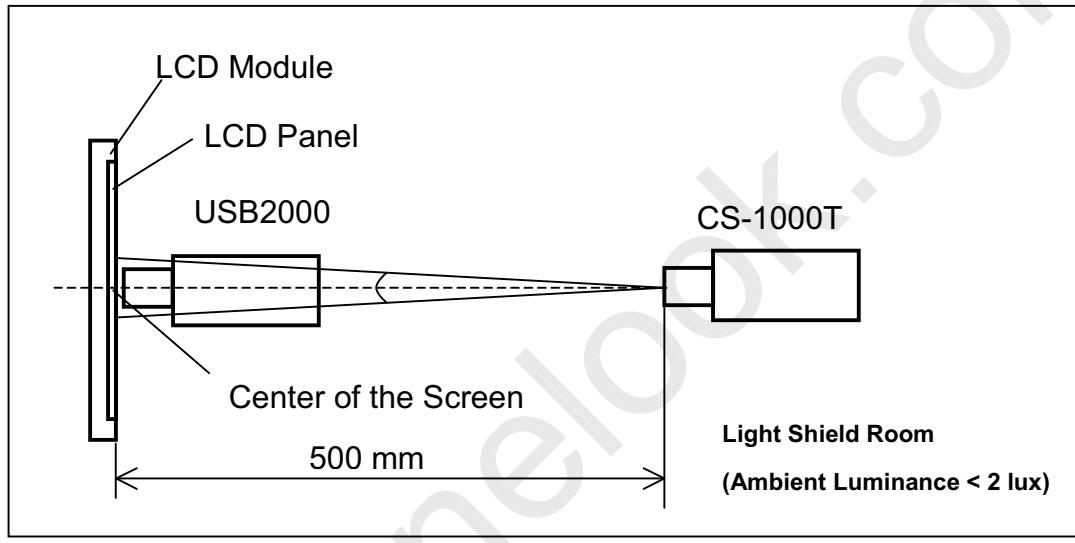
Measure the luminance of gray level 63 at 5 points

$$L_{AVE} = [L(1) + L(2) + L(3) + L(4) + L(5)] / 5$$

$L(x)$ is corresponding to the luminance of the point X at Figure in Note (6)

Note (5) Measurement Setup:

The LCD module should be stabilized at given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 20 minutes in a windless room.

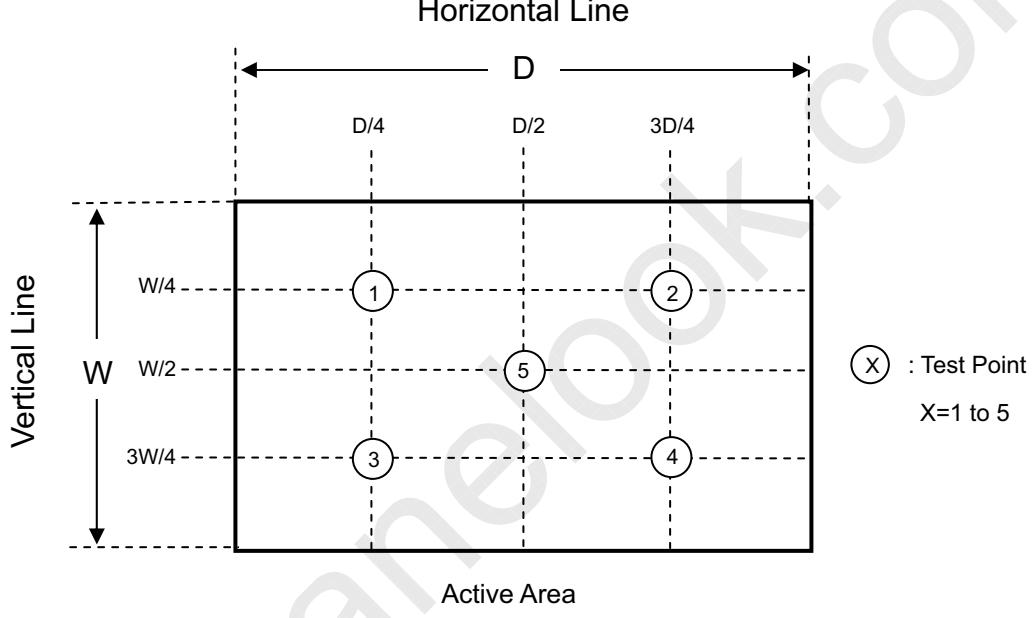




Note (6) Definition of White Variation (δW):

Measure the luminance of gray level 63 at 5 points

$$\delta W_{5p} = \text{Minimum } [L(1)+L(2)+L(3)+L(4)+L(5)] / \text{Maximum } [L(1)+L(2)+L(3)+L(4)+L(5)]$$



Note(7) The listed optical specifications refer to the initial value of manufacture, but the condition of the specifications after long-term operation will not be warranted.



9. PRECAUTIONS

9.1 HANDLING PRECAUTIONS

- (1) The module should be assembled into the system firmly by using every mounting hole. Be careful not to twist or bend the module.
- (2) While assembling or installing modules, it can only be in the clean area. The dust and oil may cause electrical short or damage the polarizer.
- (3) Use fingerstalls or soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (4) Do not press or scratch the surface harder than a HB pencil lead on the panel because the polarizer is very soft and easily scratched.
- (5) If the surface of the polarizer is dirty, please clean it by some absorbent cotton or soft cloth. Do not use Ketone type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanently damage the polarizer due to chemical reaction.
- (6) Wipe off water droplets or oil immediately. Staining and discoloration may occur if they left on panel for a long time.
- (7) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contacting with hands, legs or clothes, it must be washed away thoroughly with soap.
- (8) Protect the module from static electricity, it may cause damage to the C-MOS Gate Array IC.
- (9) Do not disassemble the module.
- (10) Do not pull or fold the lamp wire.
- (11) Pins of I/F connector should not be touched directly with bare hands.

9.2 STORAGE PRECAUTIONS

- (1) High temperature or humidity may reduce the performance of module. Please store LCD module within the specified storage conditions.
- (2) It is dangerous that moisture come into or contacted the LCD module, because the moisture may damage LCD module when it is operating.
- (3) It may reduce the display quality if the ambient temperature is lower than 10 °C. For example, the response time will become slowly, and the starting voltage of lamp will be higher than the room temperature.

9.3 OPERATION PRECAUTIONS

- (1) Do not pull the I/F connector in or out while the module is operating.
- (2) Always follow the correct power on/off sequence when LCD module is connecting and operating. This can prevent the CMOS LSI chips from damage during latch-up.
- (3) The startup voltage of Backlight is approximately 1000 Volts. It may cause electrical shock while



assembling with converter. Do not disassemble the module or insert anything into the Backlight unit.

10. PACKING

10.1 CARTON

Box Dimensions : 489(L)*382(W)*320(H)
Weight: Approx. 14.1kg(20 module .per. 1 box)

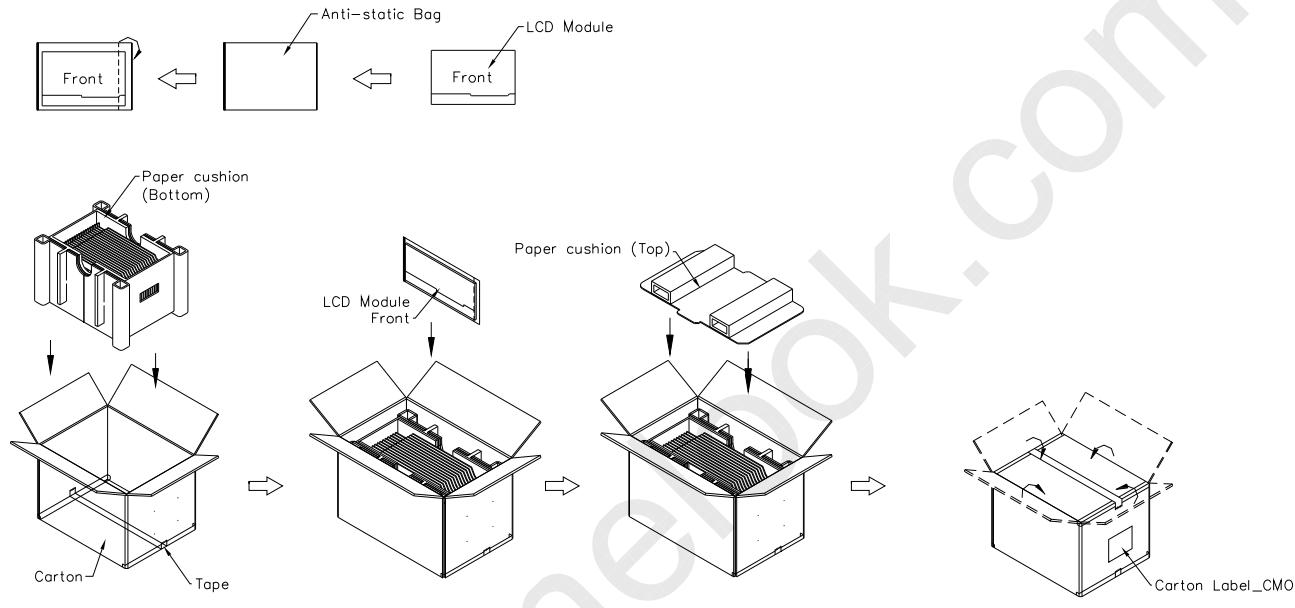
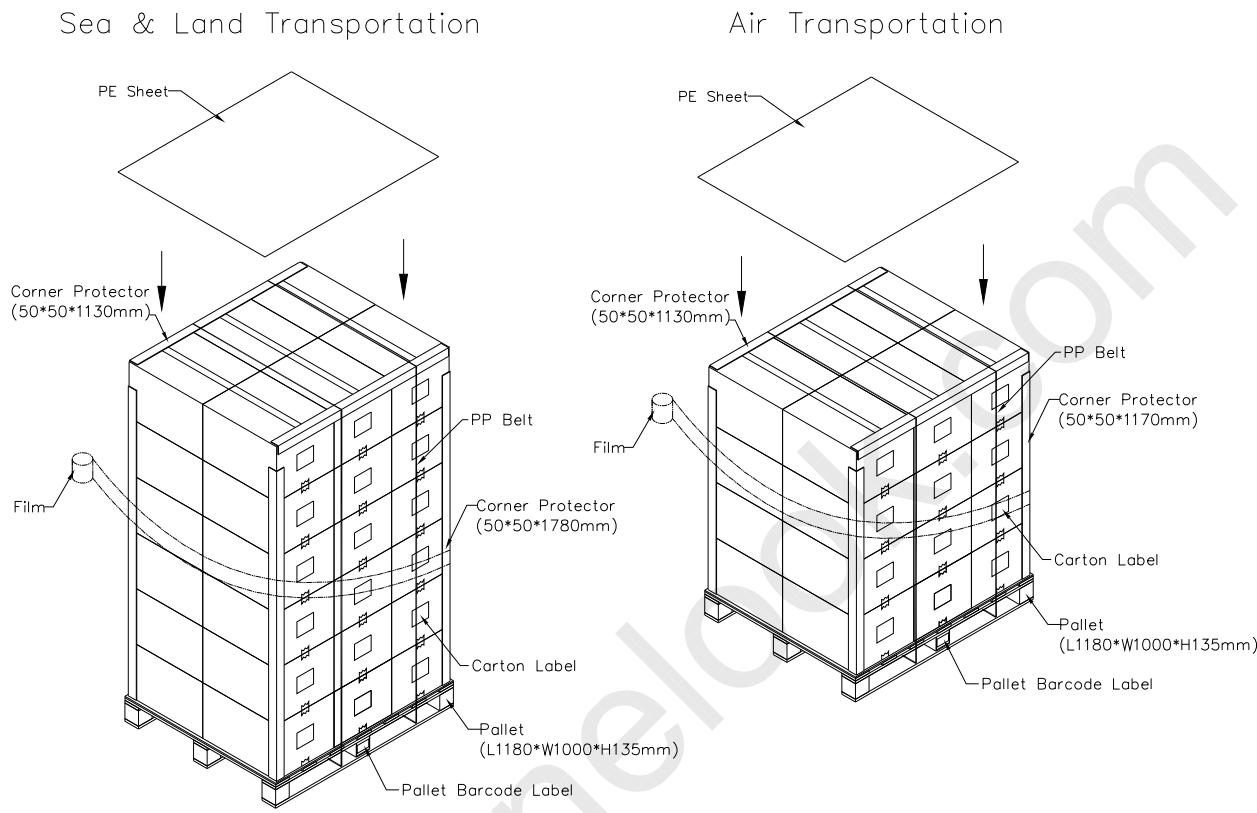


Figure. 10-1 Packing method

10.2 PALLET**Figure. 10-2 Packing method**



11. DEFINITION OF LABELS

11.1 CMO MODULE LABEL

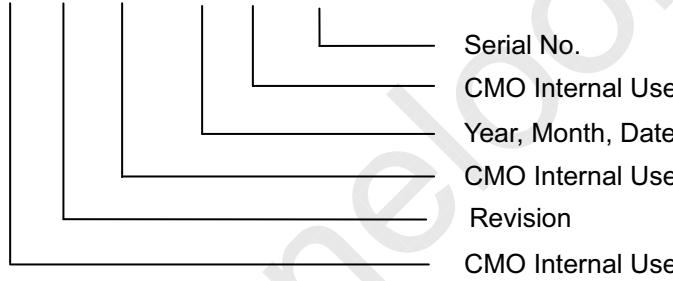
The barcode nameplate is pasted on each module as illustration, and its definitions are as following explanation.



(a) Model Name: N156O6-L01

(b) Revision: Rev. XX, for example: A1, ..., C1, C2 ...etc.

(c) Serial ID: X X X X X X X Y M D X N N N N



(d) Production Location: MADE IN XXXX. XXXX stands for production location.

(e) UL/CB logo: "LEOO" especially stands for panel manufactured by CMO Ningbo satisfying UL/CB requirement. "LEOO" is the CMO's UL factory code for Ningbo factory.

Serial ID includes the information as below:

(a) Manufactured Date: Year: 1~9, for 2001~2009

Month: 1~9, A~C, for Jan. ~ Dec.

Day: 1~9, A~Y, for 1st to 31st, exclude I, O and U

(b) Revision Code: cover all the change

(c) Serial No.: Manufacturing sequence of product

HP CT label bar code definition: (Current version is **CAYAFRRSSWWXXX**)

(a) C: Consistent display module code

(b) AAAA: Consistent assembly code for this CMO model

(c) RR: Revision code, begin from "01" and so on when version updated

(d) SS: Production location code

(e) WW: production week



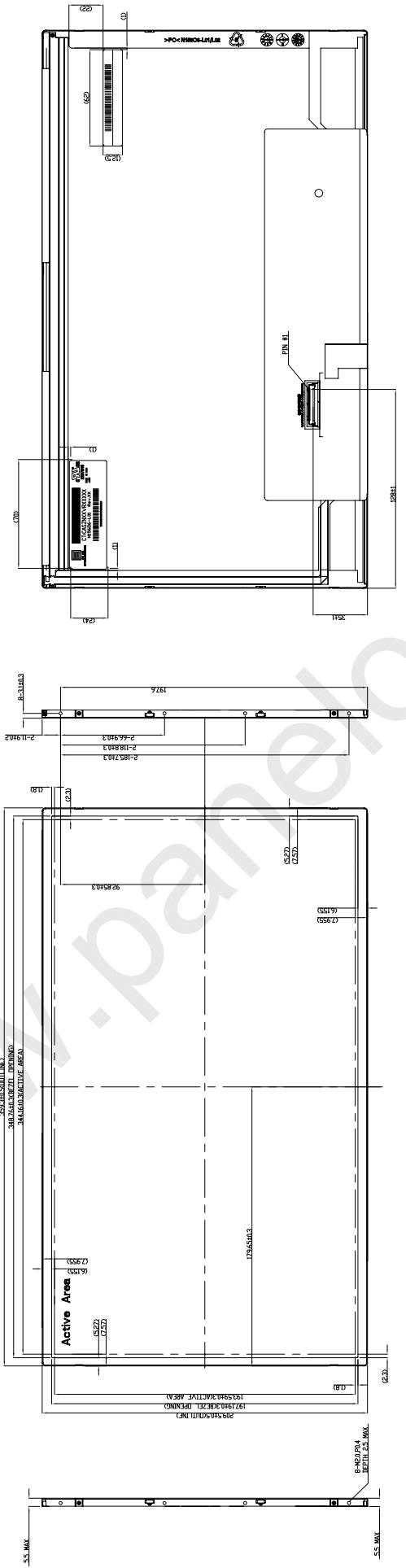
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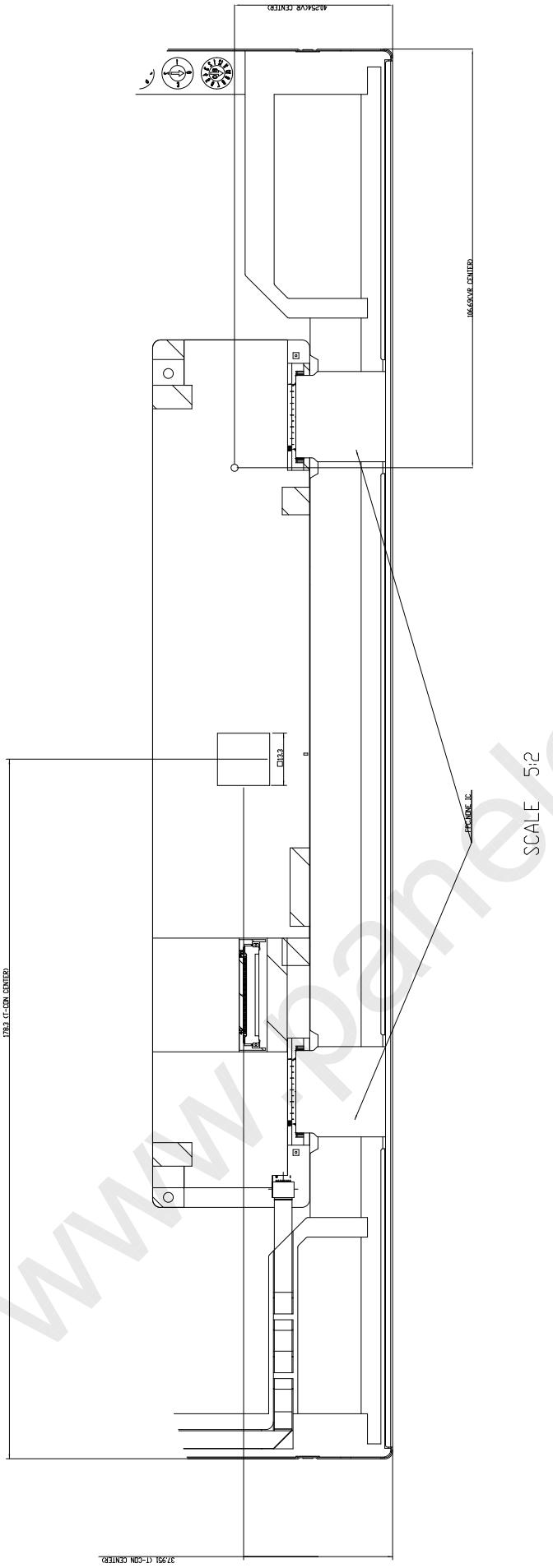
(f) XXX: serial numbers

11.2 CARTON LABEL





NOTES
 1. MAX SCREW LENGTH 2.5mm
 2. MAX SCREW TORQUE 20 kgf-cm
 3. LCD MODULE INPUT CONNECTOR - FEX 20455-040E-12 OR EQUIVALENT
 4. GAP BETWEEN BEzel AND PANEL 0.5mm MAX
 5. FLATNESS 0.5mm MAX



NOTES

In order to avoid abnormal display, pooling and white spot, no overlapping is suggested at cables, antennas, camera, WLAN, WAN or other foreign objects over COF driver IC, TCON and VR locations.